CLAIMS

1. An apparatus for controlling a temperature of a microelectronic substrate, the substrate having a first surface and a second surface opposite the first surface, the apparatus comprising:

a substrate support having at least one support surface for engaging and supporting the substrate; and

a temperature controller positioned at least proximate to the substrate support, the temperature controller having a first thermal link coupled with a first portion of the substrate and a second thermal link coupled with a second portion of the substrate, the first and second thermal links being separately controllable for transferring heat to or from the first and second portions at different rates.

2. The apparatus of claim 1 wherein the temperature controller is fixed relative to the substrate when the substrate is supported by the substrate support.

3. The apparatus of claim 1 wherein at least a portion of the substrate support is rotatable relative to the temperature controller to rotate the substrate relative to the temperature controller when the substrate is supported by the substrate support.

4. The apparatus of claim 1, further comprising a liquid supply conduit having an opening for dispensing a liquid onto the substrate.

5. The apparatus of claim 4 wherein the supply conduit is positioned adjacent the first surface of the substrate when the substrate is supported by the substrate support for disposing the fluid on the first surface, further wherein the first and second thermal links are positioned adjacent the second surface for transferring heat to or from the second surface.

6. The apparatus of claim 1 wherein the first thermal link includes a first nozzle having a first orifice directed toward the first portion of the substrate and the second thermal link includes a second nozzle having a second orifice directed toward the second portion of the substrate.

7. The apparatus of claim 6, further comprising a source of compressed gas coupled to the first and second nozzles.

8. The apparatus of claim 7 wherein the source of compressed gas includes a source of compressed air.

9. The apparatus of claim 6, further comprising a manifold coupled to the first and second nozzles.

10. The apparatus of claim 6, further comprising a source of liquid coupled to the first and second nozzles.

11. The apparatus of claim 10 wherein the source of liquid includes a source of resist solvent.

12. The apparatus of claim 1, further comprising a liquid supply coupled to a liquid supply conduit, the conduit having an opening positioned proximate to the substrate support for disposing the liquid on the substrate, the liquid including at least one of a resist material, an antireflective coating material, and a developing solution.

13. The apparatus of claim 1 wherein the first thermal link is coupled directly with the first portion of the substrate and the second thermal link is coupled directly with the second portion of the substrate.

14. The apparatus of claim 1 wherein the first thermal link includes a first electrical element spaced apart from the first portion of the substrate and the second thermal link includes a second electrical element spaced apart from the second portion of the substrate.

15. The apparatus of claim 14 wherein the substrate support includes at least one offset having an engaging surface for engaging the substrate, the engaging surface being spaced apart from the first and second electrical elements.

16. The apparatus of claim 14 wherein the first electrical element includes a first thermoelectric device and the second electrical element includes a second thermoelectric device, the thermoelectric devices configured to generate a heating effect when current is passed through the devices in a first direction and a cooling effect when current is passed through the devices in an opposite direction.

17. The apparatus of claim 1 wherein the substrate support is rotatable about a rotation axis and the first thermal link is spaced apart from the rotation axis by a first distance and the second thermal link is spaced apart from the rotation axis by a second distance different than the first distance.

18. The apparatus of claim 1 wherein the substrate support is rotatable about a rotation axis that extends through the first thermal link.

19. The apparatus of claim 1 wherein the first and second thermal links are annular relative to an axis extending generally perpendicular to at least one of the first and second surfaces of the substrate.

20. The apparatus of claim 1 wherein the first and second thermal links are concentric relative to an axis extending generally perpendicular to at least one of the first and second surfaces of the substrate.

21. The apparatus of claim 1 wherein the first thermal link includes a heat source.

22. The apparatus of claim 1 wherein the first thermal link includes a cooling source.

23. The apparatus of claim 1 wherein the substrate support includes rotatable chuck for releasably engaging the substrate.

24. The apparatus of claim 1 wherein the substrate support includes an upwardly facing bowl for retaining excess fluid that drips from the substrate.

25. The apparatus of claim 1 wherein the temperature controller includes a temperature sensor for monitoring at least one temperature of the substrate, further wherein the temperature sensor is coupled to the first and second thermal links to maintain the first and second portions of the substrate at approximately the same temperature.

26. An apparatus for controlling a temperature of a microelectronic substrate, the substrate having a first surface and a second surface opposite the first surface, the apparatus comprising:

a substrate support having an engaging surface positioned to support the substrate, the substrate support having an open portion adjacent the second surface of the substrate to allow direct thermal contact with the second surface; and

a temperature controller coupled to a source of gas, the temperature controller having at least one orifice proximate to the substrate support for directing a flow of the gas directly against the second surface of the substrate.

27. The apparatus of claim 26 wherein the engaging surface of the substrate support is rotatable relative to the orifice of the temperature controller to rotate the substrate relative to the orifice.

28. The apparatus of claim 26 wherein the orifice is a first orifice aligned with a first portion of the substrate, the source of gas having a second orifice aligned with a second portion of the substrate, the temperature controller being controllable to transfer heat at a first rate to or from the substrate through the first orifice, the temperature controller being controllable to transfer heat at a second rate to or from the substrate through the second orifice.

29. The apparatus of claim 26 wherein the source of compressed gas includes a source of compressed air.

30. The apparatus of claim 26 wherein the source of gas has a temperature less than a temperature of the substrate to cool the substrate.

31. The apparatus of claim 26 wherein the source of gas has a temperature greater than a temperature of the substrate to heat the substrate.

32. The apparatus of claim 26, further comprising:

a liquid supply conduit having an opening positioned proximate to the substrate support for disposing a liquid on the substrate; and

a source of the liquid coupled to the liquid supply conduit.

33. The apparatus of claim 26 wherein the source of fluid includes at least one of a resist material, an antireflective coating material and a developing solution.

34. The apparatus of claim 26 wherein the substrate support is rotatable about a rotation axis and the first thermal link is spaced apart from the rotation axis by a first distance and the second thermal link is spaced apart from the rotation axis by a second distance different than the first distance.

35. The apparatus of claim 26 wherein the substrate support includes a rotatable chuck for releasably engaging the substrate.

36. The apparatus of claim 26 wherein the substrate support includes an upwardly facing bowl for retaining excess fluid that drips from the substrate.

37. An apparatus for controlling a temperature of a microelectronic substrate, the substrate having a first surface and a second surface opposite the first surface, the apparatus comprising:

a substrate support having at least one support surface for engaging and supporting the substrate; and

a temperature controller positioned at least proximate to the substrate support and being generally fixed relative to the substrate when the substrate is supported by the substrate support, the temperature controller having a first thermal link coupled directly with a first portion of the substrate and a second thermal link coupled directly with a second portion of the substrate, the first and second thermal links being separately controllable for transferring heat to or from the first and second portions of the substrate at different rates.

38. The apparatus of claim 37 wherein the first thermal link includes a first nozzle having a first orifice directed toward the first portion of the substrate and the second thermal link includes a second nozzle having a second orifice directed toward the second portion of the substrate.

39. The apparatus of claim 38, further comprising a source of compressed gas coupled to the first and second nozzles.

40. The apparatus of claim 38, further comprising a source of liquid coupled to the first and second nozzles.

41. The apparatus of claim 37 wherein the first thermal link includes a first electrical element spaced apart from the first portion of the substrate and the second thermal link includes a second electrical element spaced apart from the second portion of the substrate.

42. The apparatus of claim 41 wherein the first electrical element includes a first thermoelectric device spaced apart from the first portion of the substrate and the second electrical element includes a second thermoelectric device spaced apart from the second portion of the substrate.

43. The apparatus of claim 38 wherein the first thermal link includes a heat source.

44. The apparatus of claim 38 wherein the first thermal link includes a cooling source.

45. An apparatus for controlling a temperature of a microelectronic substrate having a first surface and a second surface opposite the first surface, the apparatus comprising:

a first substrate support configured to engage the substrate;

a first temperature controller proximate to the first substrate support to transfer heat to or from the substrate while the substrate is engaged by the first substrate support in a generally stationary position relative to the first temperature controller, the first temperature controller having a first thermal link coupled directly

with a first portion of the substrate and a second thermal link coupled directly with a second portion of the substrate, the first and second thermal links being separately controllable for transferring heat to or from the first and second portions at different rates;

a second support proximate to the first support and configured to engage the substrate while a liquid material is applied to the substrate, the second support having a rotatable portion for rotating the substrate;

a second temperature controller proximate to the second substrate support to transfer heat to or from the substrate while the liquid material is applied to the substrate and while the substrate rotates, the second temperature controller having a third thermal link directly coupled with the first portion of the substrate and a fourth thermal link directly coupled with the second portion of the substrate, the third and fourth thermal links being separately controllable for transferring heat to or from the first and second portions at different rates; and

a liquid supply conduit having an opening for dispensing the liquid material onto the substrate when the substrate is supported by the second support.

46. The apparatus of claim 45 wherein at least one of the temperature controllers includes a first nozzle having a first orifice directed to the first portion of the substrate and a second nozzle having a second orifice directed to the second portion of the substrate, the first and second nozzles being coupled to a source of gas for controlling the temperature of the substrate.

47. The apparatus of claim 45 wherein at least one of the temperature controllers includes a first electrical element spaced apart from the first portion of the substrate and a second electrical element spaced apart from the second portion of the substrate.

48. The apparatus of claim 47 wherein the first electrical element includes a first thermoelectric device and the second electrical element includes a second thermoelectric device.

49. A method for uniformly coating a microelectronic substrate having a first surface and a second surface opposite the first surface, the method comprising:

disposing a liquid on the first surface of the microelectronic substrate;

rotating the microelectronic substrate about an axis generally perpendicular to the first surface; and

controlling a temperature of the first surface of the microelectronic substrate by controlling a first rate of heat transferred directly to or from a first portion of the second surface of the microelectronic substrate and controlling a second rate of heat transferred directly to or from a second portion of the second surface while the microelectronic substrate rotates, the second rate being different than the first rate.

50. The method of claim 49 wherein the first portion is spaced radially outwardly from the second portion and controlling a temperature includes transferring heat to the first portion of the microelectronic substrate at the first rate such that the first rate is higher than the second rate.

51. The method of claim 49 wherein controlling a temperature includes directing a fluid through a nozzle directly against the substrate.

52. The method of claim 51 wherein disposing a liquid includes disposing a first liquid on the first surface of the microelectronic substrate, further wherein directing a fluid includes directing a second liquid directly against the substrate.

53. The method of claim 52 wherein disposing the first liquid includes disposing a resist material on the first surface of the substrate and directing the second liquid includes directing a resist solvent toward the second surface of the substrate.

54. The method of claim 51 wherein directing a fluid includes directing a gas directly against the substrate.

55. The method of claim 54 wherein directing a gas includes directing compressed air directly against the substrate.

56. The method of claim 49 wherein disposing a liquid includes disposing at least one of a resist material, an antireflective coating material and a developing solution.

57. The method of claim 49 wherein controlling the temperature of the first surface includes passing electrical current through a resistive electrical element spaced apart from the substrate.

58. The method of claim 49 wherein controlling the temperature of the first surface includes passing electrical current through a thermoelectric device spaced apart from the substrate.

59. The method of claim 49 wherein controlling a temperature of the substrate includes transferring heat at a first rate to or from a first portion of the substrate spaced apart from the rotation axis by a first distance and transferring heat at a second rate different than the first rate to or from a second portion of the substrate spaced apart from the rotation axis by a second distance different than the first distance.

60. The method of claim 49 wherein controlling a temperature includes heating the substrate.

61. The method of claim 49 wherein controlling a temperature includes cooling the substrate.

62. The method of claim 49, further comprising releasably attaching the substrate to a rotatable chuck.

63. The method of claim 49, further comprising collecting in an upwardly facing bowl excess fluid that drips from the substrate.

64. A method for controlling a temperature of a microelectronic substrate in connection with disposing a liquid on a surface of the substrate, comprising:

controlling a first rate of heat transfer directly to or from a first portion of the substrate;

controlling a second rate of heat transfer directly to or from a second portion of the substrate, the second heat transfer rate being different than the first heat transfer rate; and

disposing the liquid on a surface of the substrate.

65. The method of claim 64, further comprising rotating the substrate to distribute the liquid over the surface of the substrate.

66. The method of claim 64 wherein controlling a temperature includes directing a gas through a nozzle to impinge directly against the substrate.

67. The method of claim 64 wherein the liquid is a first liquid and controlling a temperature includes directing a second liquid directly against the substrate.

68. The method of claim 67 wherein disposing the first liquid includes disposing a resist material on the first surface of the substrate and directing the second liquid includes directing a resist solvent toward the second surface of the substrate.

69. The method of claim 64 wherein disposing a liquid includes disposing at least one of a resist material, an antireflective coating material and a developing solution.

70. The method of claim 64 wherein controlling the temperature of the first surface includes passing electrical current through a resistive electrical element spaced apart from the substrate.

71. The method of claim 64 wherein controlling the temperature of the first surface includes passing electrical current through a thermoelectric device spaced apart from the substrate.

72. The method of claim 64 wherein transferring heat includes heating the substrate.

73. The method of claim 64 wherein transferring heat includes cooling the substrate.

74. A method for controlling a temperature of a microelectronic substrate during application of a liquid to the substrate, the substrate having a first surface and a second surface opposite the first surface, the method comprising:

disposing the liquid on the first surface of the substrate;

rotating the substrate to distribute the liquid over the first surface of the substrate;

directing a gas flow directly against the second surface of the substrate to control a temperature of the first surface of the substrate.

75. The method of claim 74 wherein directing a gas flow includes directing a flow of compressed air.

76. The method of claim 74 wherein directing a gas flow includes directing a first gas flow toward a first portion of the substrate to transfer heat to or from the first portion at a first rate and directing a second gas flow toward the second portion of the substrate to transfer heat to or from the second portion at a second rate different than the first rate.

77. The method of claim 74 wherein disposing the liquid includes disposing a liquid resist material on the substrate.